#13

DECLARATION

I, James G. Morgan, a British subject of Markgrafenstr. 8, 81827 Munich, West Germany, do hereby declare that I am conversant with the English and German languages and that I am a competent translator thereof.

I verify that the attached English translation is a true and correct translation of the specification of the PCT application, PCT/EP00/06468.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signed:

James G. Morgan

this 11th day of December 2001

Manitz & Finsterwald Partner
Gesellschaft des bürgerlichen Rechts

Translation

Manitz, Finsterwald & Partner • Postfach 22 16 11 • 80506 München

European Patent and Trademark Office
Erhardtstrasse 27

80298 Munich

Ort, Datum / Place, Date: Munich, October 24, 2001
Unser Zeichen / Our Ref.: P 3789 - r/Sr

File #: **PCT/EP00/06468**

Applicant: **Profil Verbindungstechnik GmbH & Co. KG**

In response to the official letter of July 24, 2001

In response to the first written official letter in the matter of the international preliminary examination, we submit amended patent claims 1 to 42 and amended pages 1 to 4 and 4a of the description in triplicate. We furthermore submit a photocopy of the original application documents from which the changes made can be seen.

We would first like to state that the previous claim 23 has been combined with the previous claim 24 to form a new claim 23 within the sense of Item V.2 of the official letter; whereupon the remaining claims 25 to 43 had to be renumbered. These represent the new claims 24 to

München ▪ Alicante
▪ European Patent Attorneys
▪ European Trademark Attorneys
▪ Patent- und Rechtsanwälte

▪ Deutsche Patentanwälte
European Patent and Trademark Attorneys

Dr. Gerhart Manitz
▪ Dipl.-Phys.

Manfred Finsterwald
▪ Dipl.-Ing., Dipl.-Wirtsch.-Ing.

Dr. Heliane Heÿn
▪ Dipl.-Chem.

Dr. Martin Finsterwald
▪ Dipl.-Ing.

Stephan Thul
▪ Dipl.-Phys.

Dr. Dieter Pellkofer
▪ Dipl.-Ing.

Christian Schmidt
▪ Dipl.-Phys.

Günther Kurz
▪ Dipl.-Ing.

Jörg Ewert
▪ Dipl.-Phys.

▪ British and European Patent and Trademark Attorney

James G. Morgan
▪ B. SC. (Phys.), D.M.S.

▪ Rechtsanwältin

Marion Christiane Schmidt

▪ Postfach 22 16 11
80506 München

Robert-Koch-Str. 1
80538 München

Tel. (089) 21 99 430
Fax (089) 29 75 75

e-mail manitz@patente.de
Internet www.patente.de

42 and the dependencies of the claims were changed accordingly.

In amending the claims, we have done our best to follow the remarks of the examiner with respect to the question of the unity in Section IV.2-2.4; however, we would like to state that the applicant reserves the right, after the transition into the national phase, to further pursue certain groups of claims, such as the plunger arrangement in accordance with the original claims 41 to 43 in a divisional application if required, and indeed without these including the features of the die as is the case with the amended claims 40 to 42.

In Section V.1.1 it is objected that the subject of claim 1 is not new, and indeed with a reference to US patent US-A-4,064,617 (D). The applicant cannot agree to the analysis of the examiner in this respect, and indeed for the following reasons:

The method of the application is intended in particular for the liquid-tight attachment of a functional element, and for this purpose the sheet metal part is not pierced by the functional element so that the sheet metal part is present, so to say, as a sealing membrane and the sealing of the joint can be ensured.

In D1, in contrast, the nut element is pushed through the sheet metal part such that an opening is produced so that a liquid-tight or even gas-tight joint cannot be produced here.

If the joint shown in D1 had been achieved with a circular element – which in no way belongs to the disclosure content of D12 – then, under certain circumstances, it would be conceivable to consider the position

of the joint between the element and the sheet metal part as sealed. However, the nut element has an orifice which in any event precludes a sealed joint. There is thus already a significant difference between the method in accordance with the present application and D1. However, it is appropriate to say there that the nut element of D1 is square in plan view. The die is also made square in plan view in the region of the shaped parts and it therefore extremely difficult here to achieve a sealed joint in the corner regions.

The "square" design of the die and of the element in accordance with D1 also results in a material difference with respect to the element, die and method in accordance with the present application, since here the shaped parts of the die define a cylindrical reforming space which has a base and D1 does not include such a cylindrical reforming space with a base. The corresponding features of the cylindrical reforming space, which has a base, was introduced into the amended version of claim 1 in order to clearly emphasize this difference. These features are disclosed on page 12 in lines 2 to 5.

Even if the examiner were to put forward the opinion that a reforming space is present in the die of D1, this is not cylindrical, but square in cross-section and it has no base.

Furthermore, claim 1 requires in the submitted, examined version that the shaped parts are kept immobile during the reforming. This is not the case in D1. This can be seen, for example, from a comparison of Figures 3 and 4, which shows that the shaped parts of the die move in the axial direction during the reforming of the sheet metal part or of the element.

When taking into account these differences and, above all, the fact that D1 is not a method for the liquid-tight and/or gas-tight attachment of a functional element, we are of the opinion that it is still correct to start from DE-A-19647831 already named in the description which likewise deals with such a method for the liquid-tight and/or gas-tight attachment of a functional element. However, we have taken this opportunity to make the delimitation with respect to this document more correct in claim 1.

Although one aims to achieve such a liquid-tight and/or gas-tight attachment of a functional element while using the present invention, the method can nevertheless be used with a pierced metal sheet (please also see claim 5) if, for whatever reason, the user places no importance on such a liquid-tight and/or gas-tight joint. For this reason, the claim should not be specifically limited to such a liquid-tight and/or gas-tight joint.

If, as we believe, claim 1 differs from D1 in a patentable manner, then claims 2 to 5 should also be allowed to remain in the application.

While we are of the opinion that the method in accordance with claim 6 is very important, procedures are nevertheless thinkable which would not necessarily require the special features of claim 6; these features

were therefore also not included in claim 1. For this reason, it is currently preferred not to combine claim 6 with claim 1.

As already stated, the applicant was pleased to take up the examiner's proposal with respect to the combination of claims 23 and 24 so that this criticism in the official letter has also been taken into account.

In other respects, the required formal changes have been made in the claims so that the applicant now hopes that a positive international examination report can be issued. Should the examiner not yet consider this possible at present, we would appreciate the opportunity to discuss the remaining criticisms with him in person or by phone since the applicant places value on the issue of a positive international preliminary examination report. From our side, such a consultation could take place in the near future.

We thank the examiner in advance for his efforts.

For the applicant

J. G. Morgan

Enclosure:
New claims 1 to 42 (in triplicate)
Photocopy of the original claims from which the changes made can be seen
Amended pages 1 to 4 and 4a of the description
Photocopy of the original pages from which the changes made can be seen

Claims

1. A method for the attachment, in particular of the liquid-tight and/or gas-tight attachment, of a functional element (210), in particular a fastener element, to a sheet metal part (212), wherein the functional element (210) provided with a hollow head part (210a) is pressed against the sheet metal part (212) supported by a die (214), characterized in that with a simultaneous deformation of the hollow head part (210a) and a reforming of the sheet metal part (212) into a cylindrical reforming space (230), which has a base and is defined by shaped parts (216) of the die, the sheet metal material is formed into an undercut (324) made by deformation of the head part (210a), with the shaped parts being immovably held during the reforming, but being partly lifted out of the die for the removal of the functional element attached to the sheet metal part.

2. A method in accordance with claim 1, characterized in that sheet metal material is brought into engagement with shaped features (231, 233), in particular of groove-like and/or rib-like shape, formed at the end of the shaped parts (216) adjacent to the sheet metal material by the press force applied to the functional element (210) during the reforming and in that both the sheet metal part (212) and the region of the head part (210a) above it are deformed thereby to form a security against rotation.

3. A method in accordance with claim 1 or claim 2, characterized in that the sheet metal material is first pressed into the undercut (324) and preferably brought into engagement with the shaped features forming the security against rotation after the sheet metal part (212) has been at least partly formed into the reforming space (230) by the functional element (210) moved in the direction of a longitudinal axis (222) of the die (214) for the attachment to the sheet metal part and has, in particular, been provided with a collar-like or pot-like recess.

4. A method in accordance with one of the preceding claims, characterized in that the sheet metal part (212) is not perforated, i.e. is not pierced, at least in the region of the functional element (210) during its attachment to the sheet metal part (212).

5. A method in accordance with one of the claims 1 to 3, characterized in that a pre-pierced sheet metal part is used at the point of the attachment of the hollow head part (210a) of the functional element (210), with the opening being substantially smaller in diameter than the outer diameter of the hollow head part (210a).

6. A method in accordance with one of the preceding claims, characterized in that the shaped parts (216) are arranged in segment-like manner around an abutment element (234), which has a dome-like projection (234c), to form the reforming space (230), with the deformation of the cigar-shaped end of the hollow head part (210a) of the functional element being partly carried out by means of this projection (234c).

7. A method in accordance with one of the preceding claims, characterized in that the shaped parts (216) are partly lifted out of a conical seat of the die (214) and pivoted radially outwardly to release the component assembly comprising the sheet metal part (212) and the functional element (210).

8. A method in accordance with any one of the preceding claims, characterized in that in the deformation of the hollow head part (210a) of the functional element, this is reformed into two annular folds or annular bulges (320 and 322) spaced from one another by the undercut (324).

9. A method in accordance with claim 8, characterized in that the sheet metal material of the sheet metal part, which protrudes into the undercut (324), is also formed as an annular fold or annular bulge (326).

10. A method in accordance with claim 9, characterized in that the sheet metal material of the sheet metal part, which is reformed into a pot-like shape, surrounds the deformed head part (210a) of the functional element (210).

11. A method in accordance with claim 10, characterized in that the base region of the sheet metal part (212) reformed into a pot-like shape is given a convex shape facing towards the shaft part of the functional element.

12. A method in accordance with claim 10 or claim 11, characterized in that the annular fold (322) of the head part (210a) of the functional element (210) adjacent to the base region is reformed into the corner region of the pot-like recess of the sheet metal part (212) which is formed between the base region and the side wall of the pot-like recess.

13. A die (214) for use in a method in accordance with any one of the preceding claims, characterized by a hollow body (215) having an end face (296) which is provided to support a sheet metal part and which merges via a conically tapering wall (226) into a space (227) receiving an abutment element (234), with the abutment element being spaced from the conically tapering wall to form an annular gap of wedge-shaped cross-section and with the end face of the abutment element adjacent to the end face of the hollow body being set back from the end of the hollow body and having a dome-like projection (234c) surrounded by an annular surface (234d), and further characterized by several, preferably from two to 8, in particular four, shaped parts (216) preferably of substantially the same design which are arranged around a longitudinal axis (222) of the die (214) in the wedge-shaped annular gap and are supported both at the conical wall (226) and at the abutment element (234) as well as by a reforming space (230) which is formed between the shaped parts (216) and the set-back end of the abutment element and into which shaped projections (220) of the shaped parts (216) project.

14. A die in accordance with claim 13, characterized in that each shaped part (216) is arranged in segment-like manner like wedges of

cake around the longitudinal axis (222) of the die (214) around the abutment element (234) of the die (214).

15. A die in accordance with claim 13 or claim 14, characterized in that the shaped projections (220) of the shaped parts (216) have a nose-like shape when cut in a longitudinal plane of the die and are provided in the region of the end face of the shaped parts (216) arranged adjacent to the said end face of the hollow body.

16. A die in accordance with one of the claims 13 to 15, characterized in that the shaped parts (216) are provided in their end faces adjacent to the above-named end faces of the hollow body with shaped features, in particular with radially and obliquely extending grooves (331) and noses (333) lying therebetween, which serve in particular for the formation of a security against rotation between a functional element (210) and a sheet metal part (212) when the die (214) is used.

17. A die in accordance with any one of the claims 13 to 16, characterized in that each shaped part (216) is designed to be replaceable.

18. A die in accordance with any one of the claims 13 to 15, characterized in that the abutment element (234) has a cylindrical region adjacent to the shaped parts against which the shaped parts (216) abut.

19. A die in accordance with claim 18, characterized by an elastic resetting element (228) which biases the abutment element (234) in the

direction of the said end face of the hollow body (215) against an annular shoulder of this body.

20. A die in accordance with any one of the preceding claims 13 to 19, characterized in that the shaped parts (216) each have recesses (288) extending in the longitudinal direction of the die (214) into which pins (284) fixedly arranged in the hollow body of the die project and secure the shaped parts (216) against complete removal from the die during their movement for the release of the sheet metal part with an attached functional element.

21. A die in accordance with claim 20, characterized in that the axial length of the recesses (288) less the axial height of the pins (286) at least substantially corresponds to the maximally provided stroke of the shaped parts (216) in the axial direction of the die (214) for the release of the sheet metal part and permits a corresponding pivotal movement of the shaped parts (216).

22. A die in accordance with claim 20 or claim 21, characterized in that the width of the recesses (288) transverse to their axial direction corresponds to the diameter of the pins (286) penetrating into these.

23. A functional element for attaching, in particular, but not exclusively, for attachment in a liquid-tight or gas-tight manner, to a sheet metal part, in particular in accordance with a method in accordance with any one of the claims 1 to 12 and/or using a die in accordance with at least one of the claims 13 to 22, characterized in that the functional element 210 comprises a shaft part (210b) and a head

part (210a) designed for a riveted joint to a panel member, in particular to a sheet metal part (212) in that at least the head part (210a) is made hollow and preferably has at least substantially the same outer diameter as the shaft part (210b) and in that the hollow head part (210a) has a preferably at least substantially partly spherical rounded shape (268) at its end remote from the shaft part, with said rounded shape ending in particular in an at least substantially circular aperture (270) at the end face which is preferably arranged in a plane perpendicular to the longitudinal axis (236) of the functional element.

24. A functional element in accordance with claim 23 , characterized in that the open end face (271) of the element is rounded so as not to damage the component or the sheet metal part.

25. A functional element in accordance with claim 23 or claim 24, characterized in that the cylindrical side wall of the head part (210a) of the functional element is made compressible so that when the functional element is being attached, the wall can be deformed to form an undercut (326) into two radially outwardly projecting annular bulges or annular folds (320 and 322) spaced from one another.

26. A functional element in accordance with any one of the preceding claims, characterized in that the end face aperture (270) is provided with a wall tapering conically in the direction of the shaft part (210b) with the included angle of the wall being in the region between 30° and 120°, preferably between 45° and 90°.

27. A functional element in accordance with any one of the preceding claims 23 to 26, characterized in that it is realized as a bolt element.

28. A functional element in accordance with any one of the preceding claims 23 to 26, characterized in that it is realized as a nut element.

29. A functional element in accordance with any one of the preceding claims 23 to 28, characterized in that it has been manufactured from a tube section by high-pressure forming.

30. A functional element in accordance with any one of the preceding claims 23 to 28,9, characterized in that it is manufactured from a tube section or from wire material or bar stock by a cold forming process.

31. A component assembly comprising at least one sheet metal part (212) and at least one functional element (210) in accordance with at least one of the claims 23 to 29, which is manufactured in accordance with a method in accordance with at least one of the claims 1 to 12 and/or using a die (214) in accordance with at least one of the claims 13 to 22, characterized in that a hollow head part (210a) of the functional element (210) is deformed to form two annular bulges (320, 322) projecting radially outwardly and spaced from one another and between which an undercut (324) is present in which the sheet metal material is received in a form-locked manner and in that the sheet metal part (212) extends into the undercut (324) of the functional element (210).

32. A component assembly in accordance with claim 31, characterized in that the sheet metal part (212) is not perforated and not pierced at least in the region of the functional element (210), i.e. is of the joint to the functional element (210).

33. A component assembly in accordance with claim 31 or claim 32, characterized in that when a sheet metal part (212) having a coated surface is used, said surface is not damaged, at least at the side opposite the functional element (210), by the attaching of the functional element (210) to the sheet metal part (212).

34. A component assembly in accordance with at least one of the claims 31 to 33, characterized in that the head part (210a) of the functional element (210) is at least partly arranged in a pot-like recess of the sheet metal part (212).

35. A component assembly in accordance with any one of the preceding claims 31 to 34, characterized in that the head part is fully surrounded by the sheet metal part with the exception of the area adjacent to the shaft part (210b).

36. A component assembly in accordance with any one of the preceding claims 31 to 35, characterized in that the sheet metal material of the sheet metal part that protrudes into the undercut (329) is formed as an annular fold or an annular bulge (326).

37. A component assembly in accordance with any one of the preceding claims 31 to 36, characterized in that the base region of the sheet

metal part (212) formed in a pot-like manner has a convex shape (212b) facing towards the shaft part of the functional element.

38. A component assembly in accordance with any one of the preceding claims 31 to 37, characterized in that the annular fold (322) of the head part (210a) of the functional element (210) adjacent to the base region is reformed into the corner region of the pot-like recess of the sheet metal part (212) which is being formed between the base region and the side wall of the pot-like recess.

39. A component assembly in accordance with any one of the preceding claims 31 to 38, characterized in that the sheet metal part has oblique noses (334) extending in the radial direction and spaced from one another in the region where the pot-like recess merges into the general plane of the sheet metal part (212), with said noses (334) forming channels on the side adjacent to the sheet metal part, and in that the upper annular bulge (320) has corresponding noses which engage inside the channels with the noses (334) of the sheet metal part in a form-locked manner for the security against rotation.

40. A plunger arrangement for use with a functional element (210) with a shaft part (210b) having shaped features and with a head part (210a), in particular a functional element in accordance with any one of the claims 23 to 30, characterized by

- an outer plunger (403);
- an inner plunger (404) which is displaceably arranged with respect to the outer plunger within a plunger passage (402) of the outer plunger between a receiving position for the functional

element (210) and an insertion position for the functional element (210), with the functional element (210) being able to be inserted into the plunger passage (402), preferably from the side, when in the receiving position, and with the head part (210a) of the functional element projecting out of the plunger arrangement (400) when in the insertion position; and

- by at least two segments (426) supported by the outer plunger which preferably have shaped features (432) at an inner side (430) which can engage into the shaped features of the shaft part (210b) of the functional element and which are movable between an open position remote from the shaft part (210b) of the functional element and a closed position in engagement with the shaped features of the shaft part (210b).

41. A plunger arrangement in accordance with claim 40, characterized in that the outer plunger has an upper part (414) and a lower part (412) fixed to the upper part, with a conical recess (420) arranged concentrically to the longitudinal axis (405) of the die being provided in the lower part (412) and the segments (426) having corresponding conical areas (442); in that the segments are upwardly biased in the direction of the upper part (414), against said upper part (414), by spring-biased tappets (448) preferably set obliquely to the longitudinal axis (405) of the plunger arrangement, with their shaped features (432) in this position being able to engage in those (211) of the functional element (210) urged forward under the pressure of the inner plunger (404); and in that the tappets (448) can be displaced back by means of a drawing force exerted on the functional element and drawing it out of the plunger passage and the segments and

can move against the conical recess (420) of the lower part and thus into the open position to release the functional element.

42. A plunger arrangement in accordance with claim 41, characterized in that the upper part (414) of the outer plunger (403) has a conical recess (422) to center the segments and which is likewise arranged concentrically to the longitudinal axis (405) of the die and in that the segments (426) have further conical areas (438) which come into engagement with said conical recess (422) in the closed position.

Claims

1. A method for the attachment, in particular of the liquid-tight and/or gas-tight attachment, of a functional element (210), in particular a fastener element, to a sheet metal part (212), wherein the functional element (210) provided with a hollow head part (210a) is pressed against the sheet metal part (212) supported by a die (214), characterized in that with a simultaneous deformation of the hollow head part (210a) and a reforming of the sheet metal part (212) into a cylindrical reforming space (230), which has a base and is defined by shaped parts (216) of the die, the sheet metal material is formed into an undercut (324) made by deformation of the head part (210a), with the shaped parts being immovably held during the reforming, but being partly lifted out of the die for the removal of the functional element attached to the sheet metal part.

Gelöscht: characterized in that

Gelöscht: and

2. A method in accordance with claim 1, characterized in that sheet metal material is brought into engagement with shaped features (231, 233), in particular of groove-like and/or rib-like shape, formed at the end of the shaped parts (216) adjacent to the sheet metal material by the press force applied to the functional element (210) during the reforming and in that both the sheet metal part (212) and the region of the head part (210a) above it are deformed thereby to form a security against rotation.

3. A method in accordance with claim 1 or claim 2, characterized in that the sheet metal material is first pressed into the undercut (324) and preferably brought into engagement with the shaped features forming the security against rotation after the sheet metal part (212) has been at least partly formed into the reforming space (230) by the functional element (210) moved in the direction of a longitudinal axis (222) of the die (214) for the attachment to the sheet metal part and has, in particular, been provided with a collar-like or pot-like recess.

4. A method in accordance with one of the preceding claims, characterized in that the sheet metal part (212) is not perforated, i.e. is not pierced, at least in the region of the functional element (210) during its attachment to the sheet metal part (212).

Gelöscht: at least

5. A method in accordance with one of the claims 1 to 3, characterized in that a pre-pierced sheet metal part is used at the point of the attachment of the hollow head part (210a) of the functional element (210), with the opening being substantially smaller in diameter than the outer diameter of the hollow head part (210a).

Gelöscht: at least

6. A method in accordance with one of the preceding claims, characterized in that the shaped parts (216) are arranged in segment-like manner around an abutment element (234), which has a dome-like projection (234c), to form the reforming space (230), with the deformation of the cigar-shaped end of the hollow head part (210a) of the functional element being partly carried out by means of this projection (234c).

Gelöscht: at least

Gelöscht: at least

7. A method in accordance with one of the preceding claims, characterized in that the shaped parts (216) are partly lifted out of a conical seat of the die (214) and pivoted radially outwardly to release the component assembly comprising the sheet metal part (212) and the functional element (210).

8. A method in accordance with any one of the preceding claims, characterized in that in the deformation of the hollow head part (210a) of the functional element, this is reformed into two annular folds or annular bulges (320 and 322) spaced from one another by the undercut (324).

9. A method in accordance with claim 8, characterized in that the sheet metal material of the sheet metal part, which protrudes into the undercut (324), is also formed as an annular fold or annular bulge (326).

10. A method in accordance with claim 9, characterized in that the sheet metal material of the sheet metal part, which is reformed into a pot-like shape, surrounds the deformed head part (210a) of the functional element (210).

11. A method in accordance with claim 10, characterized in that the base region of the sheet metal part (212) reformed into a pot-like shape is given a convex shape facing towards the shaft part of the functional element.

12. A method in accordance with claim 10 or claim 11, characterized in that the annular fold (322) of the head part (210a) of the functional element (210) adjacent to the base region is reformed into the corner region of the pot-like recess of the sheet metal part (212) which is formed between the base region and the side wall of the pot-like recess.

13. A die (214), for use in a method in accordance with any one of the preceding claims, characterized by a hollow body (215) having an end face (296) which is provided to support a sheet metal part and which merges via a conically tapering wall (226) into a space (227) receiving an abutment element (234), with the abutment element being spaced from the conically tapering wall to form an annular gap of wedge-shaped cross-section and with the end face of the abutment element adjacent to the end face of the hollow body being set back from the end of the hollow body and having a dome-like projection (234c) surrounded by an annular surface (234d), and further characterized by several, preferably from two to 8, in particular four, shaped parts (216) preferably of substantially the same design which are arranged around a longitudinal axis (222) of the die (214) in the wedge-shaped annular gap and are supported both at the conical wall (226) and at the abutment element (234) as well as by a reforming space (230) which is formed between the shaped parts (216) and the set-back end of the abutment element and into which shaped projections (220) of the shaped parts (216) project.

Gelöscht: , in particular

14. A die in accordance with claim 13, characterized in that each shaped part (216) is arranged in segment-like manner like wedges of

cake around the longitudinal axis (222) of the die (214) around the abutment element (234) of the die (214).

15. A die in accordance with claim 13 or claim 14, characterized in that the shaped projections (220) of the shaped parts (216) have a nose-like shape when cut in a longitudinal plane of the die and are provided in the region of the end face of the shaped parts (216) arranged adjacent to the said end face of the hollow body.

16. A die in accordance with one of the claims 13 to 15, characterized in that the shaped parts (216) are provided in their end faces adjacent to the above-named end faces of the hollow body with shaped features, in particular with radially and obliquely extending grooves (331) and noses (333) lying therebetween, which serve in particular for the formation of a security against rotation between a functional element (210) and a sheet metal part (212) when the die (214) is used.

Gelöscht: at least

17. A die in accordance with any one of the claims 13 to 16, characterized in that each shaped part (216) is designed to be replaceable.

18. A die in accordance with any one of the claims 13 to 15, characterized in that the abutment element (234) has a cylindrical region adjacent to the shaped parts against which the shaped parts (216) abut.

19. A die in accordance with claim 18, characterized by an elastic resetting element (228) which biases the abutment element (234) in the

direction of the said end face of the hollow body (215) against an annular shoulder of this body.

20. A die in accordance with any one of the preceding claims 13 to 19, characterized in that the shaped parts (216) each have recesses (288) extending in the longitudinal direction of the die (214) into which pins (284) fixedly arranged in the hollow body of the die project and secure the shaped parts (216) against complete removal from the die during their movement for the release of the sheet metal part with an attached functional element.

21. A die in accordance with claim 20, characterized in that the axial length of the recesses (288) less the axial height of the pins (286) at least substantially corresponds to the maximally provided stroke of the shaped parts (216) in the axial direction of the die (214) for the release of the sheet metal part and permits a corresponding pivotal movement of the shaped parts (216).

22. A die in accordance with claim 20 or claim 21, characterized in that the width of the recesses (288) transverse to their axial direction corresponds to the diameter of the pins (286) penetrating into these.

23. A functional element for attaching, in particular, but not exclusively, for attachment in a liquid-tight or gas-tight manner, to a sheet metal part, in particular in accordance with a method in accordance with any one of the claims 1 to 12 and/or using a die in accordance with at least one of the claims 13 to 22, characterized in that the functional element 210 comprises a shaft part (210b) and a head

part (210a) designed for a riveted joint to a panel member, in particular to a sheet metal part (212) in that at least the head part (210a) is made hollow and preferably has at least substantially the same outer diameter as the shaft part (210b) and in that the hollow head part (210a) has a preferably at least substantially partly spherical rounded shape (268) at its end remote from the shaft part, with said rounded shape ending in particular in an at least substantially circular aperture (270) at the end face which is preferably arranged in a plane perpendicular to the longitudinal axis (236) of the functional element.

Gelöscht: .¶
¶
24. . A functional element in accordance with claim 23, characterized

24. A functional element in accordance with claim 23, characterized in that the open end face (271) of the element is rounded so as not to damage the component or the sheet metal part.

Gelöscht: 5
Gelöscht: or claim 24

25. A functional element in accordance with claim 23 or claim 24, characterized in that the cylindrical side wall of the head part (210a) of the functional element is made compressible so that when the functional element is being attached, the wall can be deformed to form an undercut (326) into two radially outwardly projecting annular bulges or annular folds (320 and 322) spaced from one another.

Gelöscht: 6
Gelöscht: , or claim 25

26. A functional element in accordance with any one of the preceding claims, characterized in that the end face aperture (270) is provided with a wall tapering conically in the direction of the shaft part (210b) with the included angle of the wall being in the region between 30° and 120°, preferably between 45° and 90°.

Gelöscht: 7

27. A functional element in accordance with any one of the preceding claims 23 to 26, characterized in that it is realized as a bolt element.

28. A functional element in accordance with any one of the preceding claims 23 to 26, characterized in that it is realized as a nut element.

29. A functional element in accordance with any one of the preceding claims 23 to 28, characterized in that it has been manufactured from a tube section by high-pressure forming.

30. A functional element in accordance with any one of the preceding claims 23 to 28,9, characterized in that it is manufactured from a tube section or from wire material or bar stock by a cold forming process.

31. A component assembly comprising at least one sheet metal part (212) and at least one functional element (210) in accordance with at least one of the claims 23 to 29, which is manufactured in accordance with a method in accordance with at least one of the claims 1 to 12 and/or using a die (214) in accordance with at least one of the claims 13 to 22, characterized in that a hollow head part (210a) of the functional element (210) is deformed to form two annular bulges (320, 322) projecting radially outwardly and spaced from one another and between which an undercut (324) is present in which the sheet metal material is received in a form-locked manner and in that the sheet metal part (212) extends into the undercut (324) of the functional element (210).

Gelöscht: 8
Gelöscht: 7
Gelöscht: 9
Gelöscht: 7
Gelöscht: 30
Gelöscht: 9
Gelöscht: 1
Gelöscht: 2
Gelöscht: 34

32. A component assembly in accordance with claim 31, characterized in that the sheet metal part (212) is not perforated and not pierced at least in the region of the functional element (210), i.e. is of the joint to the functional element (210).

33. A component assembly in accordance with claim 31 or claim 32, characterized in that when a sheet metal part (212) having a coated surface is used, said surface is not damaged, at least at the side opposite the functional element (210), by the attaching of the functional element (210) to the sheet metal part (212).

34. A component assembly in accordance with at least one of the claims 31 to 33, characterized in that the head part (210a) of the functional element (210) is at least partly arranged in a pot-like recess of the sheet metal part (212).

35. A component assembly in accordance with any one of the preceding claims 31 to 34, characterized in that the head part is fully surrounded by the sheet metal part with the exception of the area adjacent to the shaft part (210b).

36. A component assembly in accordance with any one of the preceding claims 31 to 35, characterized in that the sheet metal material of the sheet metal part that protrudes into the undercut (329) is formed as an annular fold or an annular bulge (326).

37. A component assembly in accordance with any one of the preceding claims 31 to 36, characterized in that the base region of the sheet

metal part (212) formed in a pot-like manner has a convex shape (212b) facing towards the shaft part of the functional element.

38. A component assembly in accordance with any one of the preceding claims 31 to 37, characterized in that the annular fold (322) of the head part (210a) of the functional element (210) adjacent to the base region is reformed into the corner region of the pot-like recess of the sheet metal part (212) which is being formed between the base region and the side wall of the pot-like recess.

Gelöscht: 9
Gelöscht: 2
Gelöscht: 8

39. A component assembly in accordance with any one of the preceding claims 31 to 38, characterized in that the sheet metal part has oblique noses (334) extending in the radial direction and spaced from one another in the region where the pot-like recess merges into the general plane of the sheet metal part (212), with said noses (334) forming channels on the side adjacent to the sheet metal part, and in that the upper annular bulge (320) has corresponding noses which engage inside the channels with the noses (334) of the sheet metal part in a form-locked manner for the security against rotation.

Gelöscht: 40
Gelöscht: 2
Gelöscht: 9

40. A plunger arrangement for use with a functional element (210) with a shaft part (210b) having shaped features and with a head part (210a), in particular a functional element in accordance with any one of the claims 23 to 30, characterized by

- an outer plunger (403);
- an inner plunger (404) which is displaceably arranged with respect to the outer plunger within a plunger passage (402) of the outer plunger between a receiving position for the functional

Gelöscht: 1
Gelöscht: in conjunction with a die in accordance with any one of claims 13 to 22
Gelöscht: 1

element (210) and an insertion position for the functional element (210), with the functional element (210) being able to be inserted into the plunger passage (402), preferably from the side, when in the receiving position, and with the head part (210a) of the functional element projecting out of the plunger arrangement (400) when in the insertion position; and

- by at least two segments (426) supported by the outer plunger which preferably have shaped features (432) at an inner side (430) which can engage into the shaped features of the shaft part (210b) of the functional element and which are movable between an open position remote from the shaft part (210b) of the functional element and a closed position in engagement with the shaped features of the shaft part (210b).

Gelöscht: (Fig. 6B)

Gelöscht: (Fig. 6C)

41. A plunger arrangement in accordance with claim 40.

Gelöscht: 2

Gelöscht: 1

Profil-Verbindungstechnik GmbH & Co. KG P 3789

A method for the attachment of a functional element; a die; a functional element; a component assembly and a plunger arrangement

The invention relates to a method in accordance with the preamble of claim 1 for the attachment, in particular for the liquid-tight and/or gas-tight attachment, of a functional element, in particular a fastener element, to a sheet metal part.

The invention further relates to a die in accordance with claim 13 and a functional element in accordance with claim 23 which can be used in the method in accordance with the invention and to a component assembly in accordance with claim 31, which can be manufactured using the method in accordance with the invention, and a plunger arrangement in combination with a die in accordance with claim 40.

Functional elements such as nuts or bolts are attached to sheet metal parts in the manufacture of automobiles, for example, in order to allow the most varied components to be joined to the sheet metal parts.

A method of the initially named kind for the attachment of a functional element to a sheet metal part is known from DE 196 47 831 A1 in which sheet metal material is brought into hooked engagement with an undercut feature of the functional element by means of a one-piece reforming die

against which the functional element is pressed with the sheet metal part lying therebetween.

Furthermore it is known to connect metal sheets to one another without using additional joint elements by pressing the metal sheets onto a die and drawing them by means of a plunger in the direction of a fixed anvil. Moveable lamella of the die, which are arranged to the side of the anvil, yield and move radially outwardly when the lower sheet metal part reaches the anvil. In this way a round collar is created which locks the metal sheets to one another.

The object of the invention is to provide a method of the initially named kind and apparatuses of the initially named kind, that is a die, a functional element, a component assembly consisting of a sheet metal part and a functional element attached thereto and a die arrangement, which ensure a good joint, which is as easy to manufacture as possible, between a sheet metal part and a functional element.

This object is satisfied in accordance with the invention methodwise in that, with a simultaneous deformation of the hollow head part and a reforming of the sheet metal part into a cylindrical reforming space, which has a base and is defined by shaped parts of the die, the sheet metal material is formed into an undercut made by deformation of the head part, with the shaped parts being immovably held during the reforming, but being partly lifted out of the die for the removal of the functional element attached to the sheet metal part.

The attachment of the functional element to the sheet metal part is made in accordance with the invention by a reforming joining technique in which the undercut is not present in the head part of the functional element from the start, but is only created during the attachment thereof by deformation of the head part. Although both the sheet metal part and the functional element undergo substantial deformation in this process, it is surprisingly possible to achieve a low-cost and reliable method which provides a high quality joint between the sheet metal part and the functional element and which can be performed in such a way that the sheet metal part is not pierced.

As a result, the sheet metal part is still absolutely liquid-tight and/or gas-tight following the attachment of the functional element and can thus also be used in environments in which such properties are indispensable.

It is, however, also possible to work with a pre-pierced sheet metal part if the functional element requires this or makes it meaningful, for example if the functional element is to be realised as a nut element, which is possible in principle.

At this point, a brief reference should be made to US-A-4,064,617, in which a nut element which is square in a plan view is introduced into a sheet metal part while using a die with movable shaped parts. A gas-tight or liquid-tight joint is not produced here. Furthermore, the shaped parts do not define a cylindrical reforming space.

The functional elements can be manufactured either in a known manner by cold forming or by other favourably priced methods.

The shaped parts of the die remain in a fixed position during the reforming, but are movably supported for the removal of the sheet metal part with the attached functional element. They can be replaced as parts subject to wear at favourable cost without having to replace the whole die. The dies can also be manufactured at a favourable price.

A preferred die for the performance of the method is characterized by the following features:

by a hollow body having an end face which is provided to support a sheet metal part and which merges into a space receiving an abutment element via a conically tapering wall, with the abutment element being spaced from the conically tapering wall to form an annular gap of wedge-shaped cross-section and with the end face of the abutment element adjoining the end face of the hollow body being set back from the end face of the hollow body and having a dome-like projection surrounded by an annular surface, and further characterised by a plurality, preferably from two to eight, in particular of four, shaped parts, preferably shaped parts of substantially the same design, which are arranged around a longitudinal axis of the die in the wedge-shaped annular gap and are supported both on the conical wall and on the abutment element and project into the shaped projections of the shaped parts through a reforming space formed between the shaped parts and the set-back end of the abutment element.

The functional element in accordance with the invention is defined in claim 23. It must be pointed out at this point, that a functional element consisting of a shaft part and a head part designed for a riveted joint to a

panel element, in particular a sheet metal part, in which at least the head part is made hollow and preferably has at least substantially the same outer diameter as the shaft part, is known from EP-A-0028109. However, this element does not have the special feature, according to which the hollow head part has, at its end remote from the shaft part, a preferably at least substantially partly spherically rounded shape which ends in particular in an opening at the end face which is at least substantially circular and which is preferably arranged in a plane perpendicular to the longitudinal axis of the functional element. In another respect, the deformation of the functional element is carried out in a different manner in accordance with EP-A-0028109, and indeed using a pre-pierced sheet metal part.

The component assembly manufactured in accordance with the invention is designed such that a hollow head part of the functional element is deformed in order to form two annular bulges which project radially outwardly, which are spaced from one another and between which there is an undercut in which the sheet metal material is received in a form-locked manner and such that the sheet metal part extends into the undercut of the functional element.

A method for the attachment of a functional element; a die; a functional element; a component assembly and a plunger arrangement

The invention relates to a method in accordance with the preamble of claim 1 for the attachment, in particular for the liquid-tight and/or gas-tight attachment, of a functional element, in particular a fastener element, to a sheet metal part.

The invention further relates to a die in accordance with claim 13 and a functional element in accordance with claim 23 which can be used in the method in accordance with the invention and to a component assembly in accordance with claim 31, which can be manufactured using the method in accordance with the invention, and a plunger arrangement in combination with a die in accordance with claim 40.

Gelöscht: which can be manufactured by the method in accordance with the invention

Functional elements such as nuts or bolts are attached to sheet metal parts in the manufacture of automobiles, for example, in order to allow the most varied components to be joined to the sheet metal parts.

A method of the initially named kind for the attachment of a functional element to a sheet metal part is known from DE 196 47 831 A1 in which sheet metal material is brought into hooked engagement with an undercut feature of the functional element by means of a one-piece reforming die

against which the functional element is pressed with the sheet metal part lying therebetween.

Furthermore it is known to connect metal sheets to one another without using additional joint elements by pressing the metal sheets onto a die and drawing them by means of a plunger in the direction of a fixed anvil. Moveable lamella of the die, which are arranged to the side of the anvil, yield and move radially outwardly when the lower sheet metal part reaches the anvil. In this way a round collar is created which locks the metal sheets to one another.

The object of the invention is to provide a method of the initially named kind and apparatuses of the initially named kind, that is a die, a functional element, a component assembly consisting of a sheet metal part and a functional element attached thereto and a die arrangement, which ensure a good joint, which is as easy to manufacture as possible, between a sheet metal part and a functional element.

This object is satisfied in accordance with the invention methodwise in that, with a simultaneous deformation of the hollow head part and a reforming of the sheet metal part into a cylindrical reforming space, which has a base and is defined by shaped parts of the die, the sheet metal material is formed into an undercut made by deformation of the head part, with the shaped parts being immovably held during the reforming, but being partly lifted out of the die for the removal of the functional element attached to the sheet metal part.

Gelöscht: by the functional element provided with a hollow head part being pressed against the sheet metal part supported by a die and

The attachment of the functional element to the sheet metal part is made in accordance with the invention by a reforming joining technique in which the undercut is not present in the head part of the functional element from the start, but is only created during the attachment thereof by deformation of the head part. Although both the sheet metal part and the functional element undergo substantial deformation in this process, it is surprisingly possible to achieve a low-cost and reliable method which provides a high quality joint between the sheet metal part and the functional element and which can be performed in such a way that the sheet metal part is not pierced.

As a result, the sheet metal part is still absolutely liquid-tight and/or gas-tight following the attachment of the functional element and can thus also be used in environments in which such properties are indispensable.

It is, however, also possible to work with a pre-pierced sheet metal part if the functional element requires this or makes it meaningful, for example if the functional element is to be realised as a nut element, which is possible in principle.

At this point, a brief reference should be made to US-A-4,064,617, in which a nut element which is square in a plan view is introduced into a sheet metal part while using a die with movable shaped parts. A gas-tight or liquid-tight joint is not produced here. Furthermore, the shaped parts do not define a cylindrical reforming space.

The functional elements can be manufactured either in a known manner by cold forming or by other favourably priced methods.

The shaped parts of the die remain in a fixed position during the reforming, but are movably supported for the removal of the sheet metal part with the attached functional element. They can be replaced as parts subject to wear at favourable cost without having to replace the whole die. The dies can also be manufactured at a favourable price.

A preferred die for the performance of the method is characterized by the following features:

by a hollow body having an end face which is provided to support a sheet metal part and which merges into a space receiving an abutment element via a conically tapering wall, with the abutment element being spaced from the conically tapering wall to form an annular gap of wedge-shaped cross-section and with the end face of the abutment element adjoining the end face of the hollow body being set back from the end face of the hollow body and having a dome-like projection surrounded by an annular surface, and further characterised by a plurality, preferably from two to eight, in particular of four, shaped parts, preferably shaped parts of substantially the same design, which are arranged around a longitudinal axis of the die in the wedge-shaped annular gap and are supported both on the conical wall and on the abutment element and project into the shaped projections of the shaped parts through a reforming space formed between the shaped parts and the set-back end of the abutment element.

The functional element in accordance with the invention is defined in claim 23. It must be pointed out at this point, that a functional element consisting of a shaft part and a head part designed for a riveted joint to a

Gelöscht: characterised in that the functional element comprises a shaft part and a head part designed for a riveted joint to a panel member, in particular a sheet metal part, in that at least the head part is made hollow and preferably has at least substantially the same outer diameter as the shaft part.

panel element, in particular a sheet metal part, in which at least the head part is made hollow and preferably has at least substantially the same outer diameter as the shaft part, is known from EP-A-0028109. However, this element does not have the special feature, according to which the hollow head part has, at its end remote from the shaft part, a preferably at least substantially partly spherically rounded shape which ends in particular in an opening at the end face which is at least substantially circular and which is preferably arranged in a plane perpendicular to the longitudinal axis of the functional element. In another respect, the deformation of the functional element is carried out in a different manner in accordance with EP-A-0028109, and indeed using a pre-pierced sheet metal part.

The component assembly manufactured in accordance with the invention is designed such that a hollow head part of the functional element is deformed in order to form two annular bulges which project radially outwardly, which are spaced from one another and between which there is an undercut in which the sheet metal material is received in a form-locked manner and such that the sheet metal part extends into the undercut of the functional element.

The present invention is furthermore directed to a special plunger arrangement which is, in particular, designed to perform the insertion of functional elements without the risk of deforming the shaft part and, in particular, its thread cylinder. For this purpose,